Math 3232 – Project #6
Theta Method

Now we get to the *vague* problem assignment in two parts.

Part One:

I want you to implement the Theta method for the non-dimensionalized heat equation $u_{xx} = u_t$, for $0 \leq x \leq 1$ with cold wall boundary conditions $u(t,0) = u(t,1) = 0$, and a general initial condition $u(0,x) = f(x)$. The code should take a user defined function $f(x)$ as an input as well as user defined mesh sizes m and n which should be defined as in the example I wrote in class using the explicit method. The output should be along the lines of the example I wrote in class.

Run various examples of your own devising and try to discover the strengths and weaknesses of the Theta method. Of particular interest is how changes in theta improve or degrade the quality of the solution for a given mesh size. I would like a nice write-up of what you found including pictures of some of your solutions.

Part Two:

Use `pdetool` to solve Laplace's equation for the 'happy face eating ice cream'. Boundary conditions are 98 degrees around the outside of the face and the eyes, 32 degrees around the mouth. Using the same region and boundary conditions solve Poisson's equation with a source term of

$$f(x,y) = 2000(1 - \sqrt{(x-x_0)^2 + (y-y_0)^2})$$

where (x_0, y_0) is some point of your own choosing inside the left eye.

If you have questions or run into problems you can see me or talk to the other students in the class. I don't mind if you help each other with understanding what needs to be done, but I do expect each of you to write his/her own code. In fact, I encourage you to talk to each other about the projects and to help one another with debugging. Use your own judgement on this.